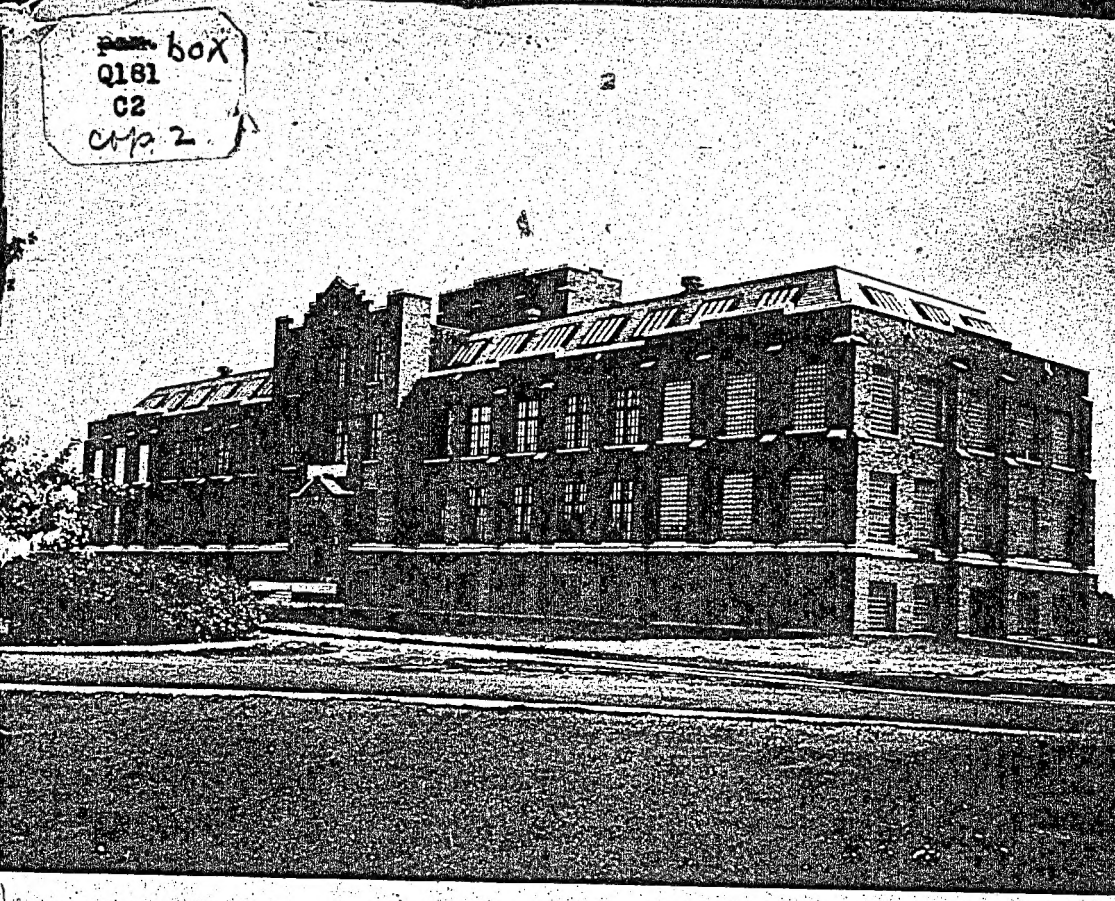


ADDRESSES

DELIVERED AT THE OFFICIAL OPENING

OF THE PRAIRIE REGIONAL LABORATORY

1948

Saskatoon,
Sask.

NATIONAL RESEARCH COUNCIL OF CANADA

INVOCATION

THE REV. PRINCIPAL N. WILLISON -
President and Dean of the Lutheran College and Seminary

Heavenly Father: Thou Who hast created us and in Whom we live and move and have our being; Thou Who art the Source of all truth and Who hast endowed man with power to walk in the avenues to truth that Thou hast placed before him and to avail himself of the means Thou hast given him to discover the mysteries of Thy universe and to harness the powers within it; Thou Who art more wonderful in majesty than our human minds can comprehend: help us to acknowledge Thee as the Almighty and Gracious God Thou art and in the deepest humility to think Thy thoughts after Thee. Help us to thank Thee for all the light that has come to us through human research and for the power and equipment for subduing the earth and for making the forces of nature serve mankind. Help us to thank Thee for the men and women who, through talents and opportunities granted by Thee, have led the way to the efficiency of the present age. We would thank Thee for the liberties we enjoy because of which we have scope for all legitimate enterprise. We ask Thee graciously to continue to bless our nation, our King and all in authority in our midst. Do Thou bless all the nations of the world that they may walk in the ways of Thy truth, wisdom and fellowship. We would thank Thee for all institutions that are promoting learning and advancing science and art and we ask Thy special blessing upon all persons who direct and study in them. Bless Thy servants whose achievements we would recognize at this function. May all achievement be subject to Thy discipline so that it may contribute to the peace and happiness of all the peoples of the earth and to Thy honour and glory. All of which we ask in the Name and for the sake of Jesus Christ, Thy Son, our Lord and Saviour.

SPECIAL CONVOCATION

Honorary graduands

Introduced by

JAMES S. THOMSON

M.A., D.D., LL.D., F.R.S.C.

President of the University of Saskatchewan

JOHN FRANKLIN BOOTH

O.B.E., M.S., Ph.D.

Associate Director of Marketing and Agricultural Economics, for his outstanding leadership in agricultural economics.

WILLIAM HARRISON COOK

O.B.E., M.Sc., Ph.D., F.A.I.C., F.R.S.C.

Director, Division of Applied Biology, National Research Council, for his eminent contributions to agricultural science.

JOHN HUBERT CRAIGIE

M.Sc., Ph.D., F.A.I.C., F.R.S.C.

Dominion Botanist, for his investigation of rust diseases in cereal crops.

KENNETH WILLIAM NEATBY

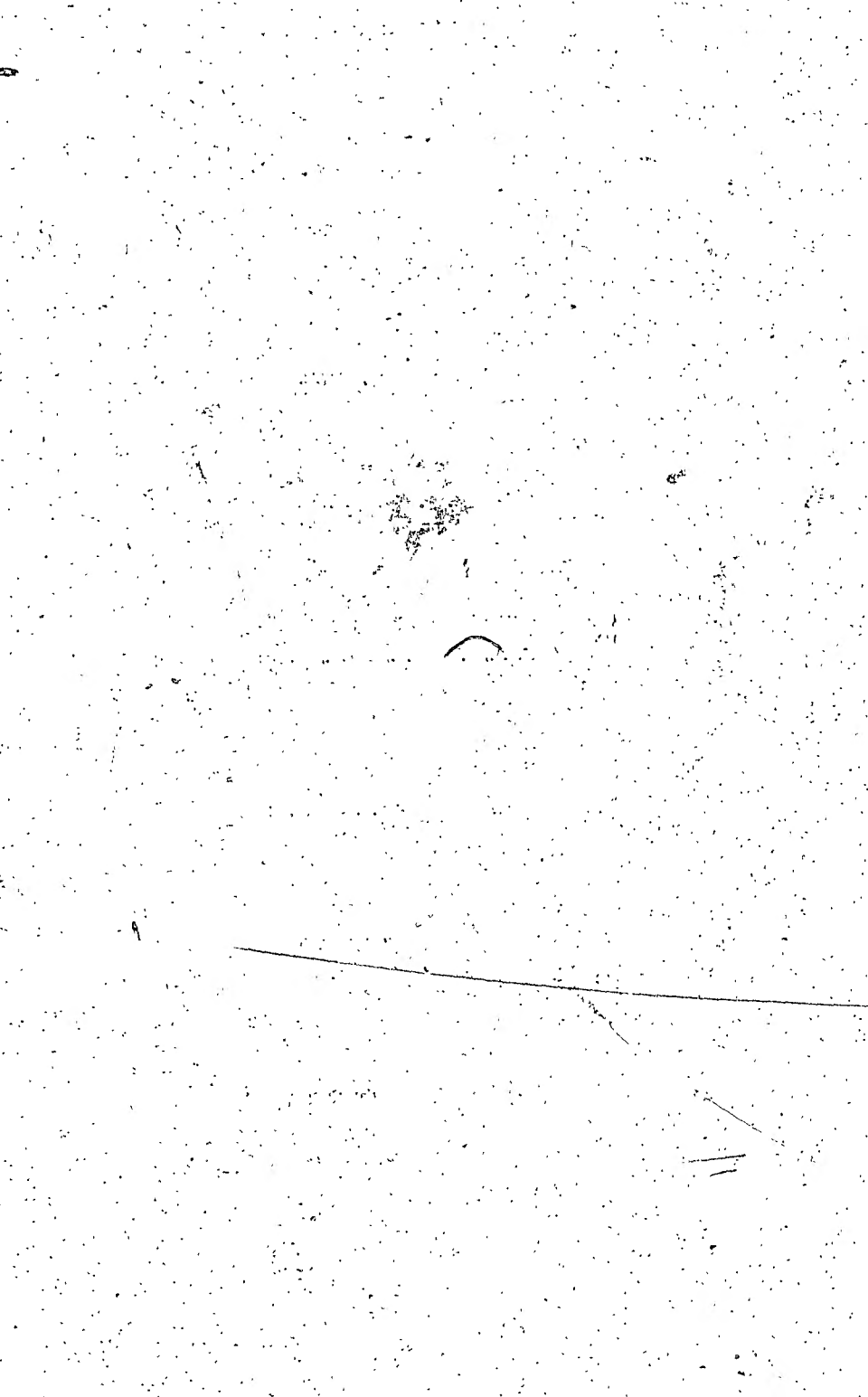
M.Sc., Ph.D., F.R.S.C.

Director, Science Service, Dominion Department of Agriculture, for his outstanding contributions to agricultural science.

ROBERT NEWTON

M.C., M.Sc., Ph.D., D.Sc., F.A.I.C., F.R.S.C.

President, University of Alberta, for his notable contribution to agricultural science and leadership in higher education.



Address by

DR. F. HEDLEY AULD, M.B.E.

Chancellor of the University of Saskatchewan

The Senate of the University of Saskatchewan was pleased to authorize at a recent meeting the holding of this Special Convocation and the conferring of the degree of Doctor of Laws upon five distinguished scientists whom we have honoured this morning.

It is our good fortune to have with us Dr. C. J. Mackenzie, President of the National Research Council, and a number of members and senior officers of the Council. We have also as our guests those members of the staff of the Dominion Department of Agriculture upon whom degrees have just been conferred. To all these honoured guests, I wish on behalf of this University to extend a very sincere and hearty welcome to our proceedings. This is the first occasion on which the National Research Council has met in Saskatoon. We hope that they will convene here on many future occasions. To the President, Dr. Mackenzie, it is a homecoming. We trust that all of the others, and particularly those who have not been here before, will feel quite at home with us.

As we are to be associated in a very few minutes in the official opening of the Prairie Regional Laboratory of the National Research Council—an event of very great significance to the people of the Canadian prairie region, I should like to outline very briefly the salient points in the relationship of this University to the National Research Council and the Dominion Department of Agriculture since both of these organizations are of great interest and importance to us.

Like other state universities, this University depends for its existence and maintenance upon the Legislature of the Government of the Province. Its charter, its capital equipment

of land, buildings and laboratory facilities were thus derived. The Provincial Government provides annual grants of money to the University in order that higher education may be as free as possible for our young people. Bursaries and Fellowships are also made available from the same source in order that research may be carried on with respect to the development and use of certain of our natural resources. The association of the University with the Dominion Government is quite different. It has to do chiefly with researches relating to agriculture and with the varied research activities of the National Research Council; although in these post-war years there has also been intimate and quite important association with the Department of Veterans' Affairs with respect to the training of former members of the Armed Services who have entered upon university courses in unprecedented numbers.

Three branches of the Dominion Department of Agriculture have been for years intimately associated with this University. The Science Service uses laboratory facilities to our mutual advantage, although much of their work in the prairie region is done in their own laboratories in other centres. They carry on important work here in the fields of entomology and plant pathology. The Experimental Farms Service maintains a staff here for research in agrostology. That Service has also assisted greatly in extending the soils survey programme in this province, and maintains a small staff here in addition to the soils research programme conducted at Swift Current. The Marketing Service works closely with our Department of Farm Management and makes an important contribution to the field of economic surveys. These are some of the more important contacts between the University and the Dominion Department of Agriculture. Not only do the staff work here, but the members of the staff have been very co-operative and helpful to the University and the Provincial

Department of Agriculture in devising plans for making their research more useful to the farmers of Saskatchewan.

Our association with the National Research Council has been equally happy, although of a different nature. From its inception in the middle of the First World War in 1916 when it was largely without laboratory facilities, the Council has greatly assisted the universities by providing bursaries and fellowships to persons qualified to carry on research projects. These payments, amounting to more than a million dollars, have been of the greatest value in training men and women, many of whom have subsequently filled important positions in the Research Council, the universities and in industry. Through this plan a great stimulus to scientific research has been given to all of our Canadian universities. The value of this policy is exemplified in the fact that the leading members of the staff of the Prairie Regional Laboratory to be opened here today are graduates of this University who have shared in this plan.

Through its Associate Committees, representative of all interested research agencies, the Council has assisted many projects of special interest to prairie farmers. In economic value the breeding of improved varieties of cereal grains to counteract the ravages of leaf and stem rust would probably rank highest in importance. This involved co-operation with the Dominion Department of Agriculture and the prairie universities. Some of those who participated in a major way in this great and continuous project are with us today. Weed investigations, assisted by the Council, have increased our knowledge of plant development and aided us in developing better methods of weed control. Some help was given in the development of a breed of sheep better adapted to prairie range and farm conditions.

Research of a fundamental nature in the uses of cement and the protection of concrete structures from deterior-

ation was supported financially by the Council at this University. Important studies were made here in the investigation of a variety of methods for insulating the walls of dwelling houses in order to make them more comfortable in extremes of weather, and similar studies of a more advanced character are now in progress. Mention might also be made of important studies in meteorology, the newer work with radioactive tracer materials and the betatron shortly to be installed here with the assistance of the Atomic Energy Commission and the Provincial Government.

Let me mention also some other phases of the work of the National Research Council of great economic value to the prairie region of Canada. Under war conditions when shipping was so severely disrupted through enemy action, the storage and preservation of food became unusually important. Many special studies were made by the staff of the Research Council to discover improved methods of handling bacon, eggs, dressed poultry and meats generally in public storages, railway cars and steamships. An emergency type of refrigeration was installed in freighters to meet emergency conditions when our losses of refrigerated ships were unusually heavy. Dehydration of eggs became an important industry under war conditions and received indispensable help from the Research Council. Assisted researches in Ontario and Quebec to test the feeding value of prairie-grown grains was a pre-war project which enlarged the market for feed grains from prairie farms.

Those of you who have been intimately associated with the developments to which I have referred briefly will be acutely aware of the very general and sketchy manner in which I have dealt with them, and how inadequate the treatment has been. I trust, however, that my remarks may have enabled others to have some appreciation of the interrelationship between the University and the two great organizations

of which I have spoken. It is probable that more details of the work of the Council will be given in the addresses which are to be given today in connection with the opening of the Prairie Regional Laboratory.

The men who have been honoured here this morning have been or are now associated with one or the other of these important institutions. Their work has been characterized by exceptional ability and a high devotion to duty. They also have, in the lines of J. Mason Knox, demonstrated the value of working together in constructive programmes for the common good:

> "It's not the guns or armament, or the money they can pay,
> It's the close co-operation that makes them win the day.
> It's not the individual or the army as a whole,
> But the everlasing teamwork of every bloomin' soul."

And so, in conclusion, I wish on behalf of the University to express to President Mackenzie and the members of the National Research Council our appreciation of their past achievements and our congratulations on the fact that this Prairie Regional Laboratory is practically completed and is now about to be officially opened. We have looked forward with great interest and pleasure to this accomplishment, and we have derived very great satisfaction from the fact that the laboratory is located on the University campus. We welcome Dr. Ledingham and his staff and wish them great success in the programme which they are undertaking. We are confident that the Prairie Regional Laboratory will be an agency of very great importance to the prairie region and to all of Canada, and we expect that its relationship to this University will ever be thoroughly cordial and mutually and profoundly helpful.

OFFICIAL OPENING
OF THE

PRAIRIE REGIONAL LABORATORY

Address by

DR. C. J. MACKENZIE
President of the National Research Council of Canada

In a few minutes it will be my privilege to declare this laboratory officially open and to dedicate it to the application of science, for the particular benefit of the Prairie Provinces.

Speaking on behalf of the members of the Honorary Council, the directing board of our National Research organization, I am able to bring to this occasion greetings from nearly every province and every university in Canada. Speaking for those Councillors who are here in person, I wish to express the pleasure we feel at being present at this ceremony which marks not merely the opening of one more unit in our laboratory series, but the forging of another link in a chain that stimulates and strengthens our Canadian scientific effort.

It is particularly fitting that the first regional laboratory of our Council should be located on the prairies, because no part of Canada has been more conscious of what the application of science can do for the well-being of a country, no section has been more liberal in its support of science, and no region has depended more on science, not for its prosperity only, but for its very existence: for without scientific agriculture there would be no Western Provinces as we see them today.

As one who stood near this very spot almost exactly 38 years ago and witnessed the first sod being turned for the first building of this University, and as one who through the succeeding years watched as a thousand acres of bald and uninhabited prairie were transformed into a bustling university

campus covered with beautiful buildings, I may be pardoned perhaps for feeling a special and personal pleasure in being associated with the addition to this campus of still another unit which, although regional in character, will nevertheless be closely associated with this University.

Our Council is pleased that the Director of this laboratory is a distinguished product of this University and we know that he and his colleagues will find themselves in most congenial surroundings. While our area of operation is restricted indeed in comparison with the broad sweep of university interests, we do hope that in this more restricted field our staff will be influenced and stimulated by the tradition of high standards, absolute integrity and genuine public service which has always characterized our western universities.

In our negotiations in connection with this enterprise we have at all times had the most sympathetic and cordial co-operation of the President and Board of Governors of this University, and this we gladly acknowledge. Our Council also is grateful for the honour and compliment paid to our association during the Convocation exercises this morning. We would like to add still further to our debt by asking President Thomson to take part in our formal ceremonies.

Address by

DR. JAMES S. THOMSON

President of the University of Saskatchewan

When the University was approached by the National Research Council to provide a site for the erection of a laboratory, we were gratified by the request and willingly made land and other facilities available. When the draft plans were prepared, we realized that a matching building for our engineering laboratories would complete this quadrangle of our campus and we have watched the progress of erection with

growing interest and anticipation. Now that we have reached the day of opening, we hold out hands of cordial welcome to the Director, Dr. Ledingham, and the members of his staff. We are gratified to take this public opportunity of expressing our appreciation of the National Research Council in setting this fine new laboratory in our midst. We feel that this is a seal of high approval on our work and worth, and on our part, we are ready to promise the fullest co-operation both in the scientific work to be carried on and in the physical arrangements of the actual building.

Co-operation with governmental agencies is no new experience for us here at the University. Already, scientific workers of agricultural departments and also of the National Research Council have found accommodation here now for many years. We have reason to believe they have found more than physical accommodation: they have found an intellectual hospitality and co-operation that has made both them and us feel that we belong together as one happy academic family. We have benefitted by their presence among us: and in turn, we like to think they have received something from us.

But today, this is a development of a well-established policy of such dimensions that it really amounts to a new beginning. For me, I have the personal gratification of sharing in a growth of national research activities that I began to advocate ten years ago with General McNaughton, and which I am glad to note now has the support and practical expression of his successor, President Mackenzie. I mean the policy of identifying research institutions with universities. We are proud and happy to be singled out as providing a home for this western institution and we look forward to the new era of co-operative research that begins to open up for us today.

DR. MACKENZIE:

No one person is more responsible for this laboratory we are opening than President Robert Newton of the University of Alberta.

Dr. Newton has for years been a leader in agricultural science and education in Canada. He has been in succession a distinguished professor and research scientist in Alberta, the creator and first Director of the Division of Biology in the National Research Council, and finally the President of a western university and a member of our Honorary Council. It is a great credit to the integrity and genuine national outlook of Robert Newton that the decision to locate the Prairie Regional Laboratory on this campus was taken on his recommendation.

This project is the culmination of a series of advances in the application of science of which Dr. Newton was the principal architect and constructor, and we are honoured in having him address us briefly at this time.

Address by

DR. ROBERT NEWTON

President of the University of Alberta

Swathed in these generous academic robes and bathed in this genial Saskatchewan sunshine, I share fully the warm feelings that characterize this occasion!

The birth of the Prairie Regional Laboratory follows a long period of gestation. It is the fulfilment of an idea—almost a dream—of long standing. In one respect it is a special child of mine, since the idea was conceived during my term of office as Director of the National Research Council's Division of Biology. Since it is now to be identified permanently with the University of Saskatchewan, I am especially gratified to be made an honorary graduate of this University. Thus I too

shall be identified with the University of Saskatchewan while I have my being, and need anticipate no parting from my foster child.

I should like to thank President Thomson and the members of his Board and Senate for accommodating the laboratory on this campus, and for lending distinction to this occasion by a special Convocation to honour a group of agricultural scientists in which I am fortunate to be numbered.

I congratulate President Mackenzie on adding one more to the several important laboratories which have increased the size and usefulness of the National Research organization during his term of office. This one will set a pattern for other regional laboratories which may follow in due course.

Finally, I congratulate Dr. Cook, whom I am proud to number among my former students at the University of Alberta as well as my successor at Ottawa, and Dr. Ledingham, who has returned to his own Alma Mater after many days to take charge of this fine new laboratory.

Now in this little opening game I have pleasure in passing the ball to Dr. Cook, Director of the Division of Applied Biology, National Research Council.

Address by

DR. W. H. COOK

Director of the Division of Applied Biology, National Research Council.

In modern times, scientific progress requires the effort of a large number of workers and even then the advances are so gradual and continuous that they often go unnoticed. Viewed through the reverse telescope of history, the contribution of the individual scientific worker seems incredibly small. To the great majority of people, contributions to modern science

are frequently associated with institutions rather than individuals. Today we are opening a new institution. In other words, an unmarked milestone has been placed in position. It is for the members of the staff to carve the contributions the laboratory can make to knowledge and western well-being.

In the past, the burden of western research activity has fallen largely on staff and students of the western universities. The opening of this building—the largest single research laboratory in Canada west of the Great Lakes—will add substantially to the facilities already available. With these increased facilities, and the existing spirit of co-operation, the scientific and industrial development of Western Canada should be accelerated.

When the Department of Scientific and Industrial Research was formed in Britain under the stress of the First World War, one of the first laboratories established was the Food Research Station at Cambridge. That laboratory and the one we are about to open have much in common. Both are government-supported; both are concerned with the ultimate use of agricultural products; both are located on the campus of a university in association with other branches of science and learning. This broad pattern, first laid down by Sir William Hardy, has proved to be successful.

The new laboratory will devote its attention to the problems and products of this prairie region. These are primarily of agricultural origin. The utilization rather than the production of agricultural materials will be its main field of activity. Throughout recent history, more attention has been given to research on the production phases and all too little attention has been given to the ultimate use of increased production. This region is no exception. The co-operative effort of government departments and universities has solved such major production problems as the rust scourge, but little

scientific information was available to deal with the surplus problems of a decade ago.

The immediate problems of the new laboratory include expanded studies on oil-seed crops in support of the recent development of an oil-seed processing industry in Western Canada. A second problem will be concerned with the utilization of straw, particularly for the manufacture of insulating materials. Fermentation of waste and surplus carbohydrates appears to be the best general procedure for converting such materials to useful chemicals, antibiotic substances, and vitamin concentrates. A large general project will be initiated in this field. Finally, the Division of Building Research will undertake work in their field of interest in co-operation with the University staff.

But scientific progress and the solution of important technical problems are not accomplished merely by providing a large building and elaborate equipment. These are only the tools. Success depends on the staff. Dr. Ledingham, the Director of this laboratory, is no stranger to the West. He comes from a farm in this Province and is a graduate of this University. During the past ten years in Ottawa, he has been in charge of much of the research on the industrial use of products of western agriculture. Some of his present staff worked in close association with him in Ottawa. This fact alone is a tribute to the qualities of leadership in the Director of the new laboratory. For this group and their scientific projects, the opening of these laboratories marks a scientific homecoming.

The resourcefulness, ability, enthusiasm and other personal qualities of Dr. Ledingham and his staff have been amply demonstrated. This buidling and the responsibility for the scientific activities its walls will contain are being placed in capable hands.

DR. MACKENZIE:

Dr. Ledingham, it is with confidence and pleasure that I now pass this key to you as a symbol of the responsibility which our Council has placed on your shoulders in naming you Director of this laboratory. We pray that you may be given the strength and wisdom to guide this institution in the best interests of science and of the peoples of these Prairie Provinces.

Address by

DR. G. A. LEDINGHAM

Director of the Prairie Regional Laboratory

In accepting this key from the President of the National Research Council I am deeply conscious of the honour which this symbol of responsibility carries. The opportunity of returning to my home province of Saskatchewan to guide the activities of this new Prairie Laboratory is a privilege which I value highly.

As a graduate of this University I am especially proud to see it located here. It is my hope that we will be able to develop and maintain the same high standards of integrity and service for which this University has long been noted. Naturally our interests extend beyond the borders of this Province to both Manitoba and Alberta. We hope to co-operate closely with all three western universities; for each has a special contribution to make from its respective region.

I would now like to invite you all to inspect our building and the facilities for research that it offers. You all know of the shortages of labor and materials that have existed during the past few years. Only the best efforts of the contractor and architect have made it possible to reach the stage of development in which you will now see it. As far as the building

is concerned the basic structure has been laid in the Ottawa laboratories. We hope to complete several unfinished projects here and to launch several new ones. Our exhibits will indicate a few of the roads we intend to follow.

As Dr. Mackenzie now cuts the ribbon, I say: Welcome to the Prairie Regional Laboratory.

DR. MACKENZIE:

By the cutting of this tape I formally open this laboratory and dedicate it to public service. You are now invited to enter the building and inspect the facilities that have been provided.

COMPLIMENTARY LUNCHEON

Address by

DR. JAMES S. THOMSON

President of the University of Saskatchewan

This is a happy day for us in the University of Saskatchewan. We are both proud and happy in the guests whom we delight to honour. We welcome to our midst the National Research Council of Canada. The members of the Council do not come among us as strangers, either personally or in their institutional character. We do not forget that our association with them has been of immeasurable benefit to us as a University. Some of these benefits have been measurable enough in terms of dollars and cents. Year after year, professors and students alike have been supported and encouraged in researches and studies by grants-in-aid and by fellowships, scholarships and bursaries, now amounting in the aggregate to hundreds of thousands of dollars. Nor have these supporting funds been the less acceptable because the projects for which they have been given were required to pass an exacting scrutiny before the money was made available. Similarly the fellowships, scholarships and bursaries have carried along with their financial value an added sense of satisfaction in that they had to be won in fierce competition with the brightest students from all the universities of Canada.

But beyond these financial benefits, there has been a value received, not so precisely measurable, but not the less real, in the encouragement given to our scientific workers and in the opportunity offered to young and eager minds.

On our part, we believe we have made no insignificant contribution to the work of the National Research Council, which exists to promote, co-ordinate and extend scientific research throughout all Canada. We shall content ourselves

on this occasion by singling out for special mention, the President of the Council, Doctor C. J. Mackenzie, or as he is more familiarly known to us, Dean Mackenzie. His colleagues will not misunderstand me when I say we have a particularly cordial welcome for him, in fact, this is a kind of home-coming reception. Since he left us nearly nine years ago, we have followed his career with pride and admiration and nowhere does his place of leade ship and influence awaken more satisfaction than here in Saskatchewan.

We have marked this happy day by honouring ourselves in the bestowal of such honours as we have to offer to distinguished men of science. And so, we have as guests our latest graduates—our Doctors of Laws, none the less deserving of this title because their acquaintance is profound and intimate with the laws of nature, rather than with the laws of men. It is peculiarly fitting that in the University of this Province where agriculture is the ruling interest to an extent far greater than anywhere else in Canada, we should honour men who have made special contributions to agricultural science. For two of them, this is not the first degree they have received at our hands. We welcome to the venerable estate of honorary doctors two of our graduates—Doctor Kenneth Neatby and Doctor John F. Booth. The Neatbys have been a great family in this Province and University—all distinguished alike by strong personalities and marked intellectual power. Our University has been notable for its pioneer work in agricultural economics. Not only in the University, but in the careers of some of our graduates, we have taken great pride in contributions to the study of farm management and agricultural marketing. High in that roll of outstanding men is Doctor Booth, who today receives our honorary degree in recognition of his outstanding leadership.

I am happy indeed that we are now able to count my friend and colleague President Newton among the honorary graduates of this University. The Universities of Alberta and Saskatchewan are sister institutions, very much alike in constitution, tradition and interest. Doctor Newton in his day has been a gallant soldier, decorated for valour in the field of battle, an illustrious scientist, an inspiring university head and to me a valued personal friend. It is a specially notable tribute to his magnanimous and public-spirited character that he should have been the Convenor of the Committee that located the new Prairie Regional Laboratory opened today on the campus of a university other than his own. We in this Province owe an immense debt to the fine work of Doctor J. H. Craigie, particularly in the arduous and successful battle against the ravages of rust. I am sure that on this day when he receives this deserved recognition at our hands, not only in our name as a university but in the name of all our people, he would wish the honoured name of that humble-minded, devoted servant of science, the late Professor W. P. Fraser of this University to be mentioned also. And last, but by no means least in this University where the study of the biological sciences has earned such wide and deserved repute, we welcome to our list of honorary graduates, the distinguished scientist, Doctor W. H. Cook, who holds the office of Director of the Division of Applied Biology of the National Research Council, in Ottawa.

This is a happy day not only for us in the University, but also for all our people of the West. We in these western universities live very close to our people. We are their creation: from them we draw our sustenance and we endeavour to be ever mindful of our responsibility to them and their welfare. I have already referred to the predominant interest of Saskatchewan in the industry of agriculture. So far as material

welfare is concerned, it is in terms of agriculture that we live and move and have our being. Already, the history of western agriculture has passed through many phases. We are not so very far away from the first excited years of western settlement —years of extravagant hopes and fabulous anticipations. Since then we have experienced many vicissitudes—economic depression, prolonged drought, all the plagues of Egypt, and many plagues of which the Egyptians never dreamed!

But, steadily through all these experiences of fortune and misfortune, our shrewd and industrious people have learned that, while we will always be exposed to the hazards of weather and the fluctuations of world-wide conditions, the practice of agriculture is an encounter of human industry with the processess of nature in the work of producing food for their fellow human-beings. The essentials of this encounter are sound knowledge, passing into skilled practice. And so our people have become research-conscious. In their daily work they have many problems to be solved, and we in this University have given a place of chief importance to the finding of answers to their questions. Time would fail me to tell of the wide range of our activities and the close co-operation of our efforts. The growing of wheat is basic and fundamental. And so we have devoted much effort to the development of varieties of cereal grains suitable for our distinctive conditions. Methods of cultivation are equally important, and particularly now that the industrial revolution has fully come to field and farm, we have given much study to agricultural mechanics and the attendant problems of engineering.

In plant ecology and plant pathology pioneer work has been done. The newest scientific methods of weed control and eradication are constantly before us. We are aware also that our finest natural resource is the good earth: hence our extensive studies in the analysis, classification and survey of

our soil. Nor do we forget other aspects of this many-sided industry: poultry, dairying, stock-raising, the investigation and control of animal diseases and the problems of animal nutrition. And we recognize to the full that all of these activities will find their final approbation in a satisfactory way of life, with a decent stability and security of income, a home that is more than a shelter from the fierce onslaught of prairie weather, a community life that is full and satisfying, schools for children and young people, roads to travel on, and medical skill available to all in the institutions of civilized life established among us.

It is a great venture we are here upon in the West, the venture of building an essentially new kind of society, different from anything the world has ever known before. We in the University are highly conscious of our share and contribution. We have constantly endeavoured to give all that scientific knowledge and research has to bring to an absorbing task, which has still the freshness and excitement of novelty and to which come ennobling rewards in the increase of the sum of human happiness and well-being.

It is therefore with peculiar satisfaction that not only for this young University of the West, but in the name of our western people, we welcome the establishment of a Prairie Research Laboratory of the National Research Council. For us this is at once a symbol and a practical evidence that our national body which is concerned with the promotion and direction of research on a national scale is conscious in a new way of the national importance of agriculture. In the University we accept with a measure of pardonable pride and satisfaction this seal of national approbation on work already accomplished and we are happy in being counted worthy to provide a home for this new institution so full of promise for our whole people. Too often there has been the suggestion that research on the national scale has been concerned mainly with the promotion

of manufacturing industries, which must, of necessity, be maintained on a large scale, and that the small operator is neglected and forgotten. Today the farmer on the prairie has the right to feel he, too, has a new place in the national concern for industrial efficiency and that all the resources of scientific research are made available to him in his fundamental toil in producing the basic essentials of life.

There is this further satisfaction that the enlightened policy of the National Research Council has placed this laboratory in a university. Nobody is better aware than the President and members of the Council that their work and that of the universities is mutually dependent. The line between what is called fundamental and applied science can never be very closely drawn. One shades inevitably into the other. But the distinction remains. In the Research Council, as in the University, scientific workers are keenly aware of how frequently the investigation of practical problems leads them back to fundamental studies. The narrow specialist is a fictional personage, whose dubious claim to merit is the very unspecialized possession of a limited capacity. On the other hand, the university professor needs the discipline of practical realities to temper his intellectual ardour by the necessity to alight, at least occasionally, on this dim spot which men call earth. The basic researches of the pure scientist and the applied investigations of the research worker have always been closely knit together in this University and we hope therefore that the new laboratory will find a congenial and hospitable atmosphere for its work.

One other matter, contemporary experience is bringing us to realize very clearly that scientific research cannot take its isolated way in the modern world. It is a function of civilized life and partakes of the character of the social environment in which it is carried on. Intellectual freedom is its charter, bu there can be no freedom for the mind, apart from

general freedom—and the enlargement and maintenance of positive freedom is one of the chief issues of contemporary civilization. By positive freedom I mean not merely absence of interference, but a sense of self-directed social responsibility and action. Universities ought to be the bulwarks of this heritage, and not merely bastions for its defence, but vantage points from which the human spirit sallies forth to make new conquests. This urge to serve mankind will depend upon our sense of social values, which science cannot itself maintain without the moral support of the humane discipline of history, literature, and not least philosophy. It is the very function of a university to provide this rich and universal atmosphere for such institutions as the Prairie Regional Laboratory.

ADDRESSES AT THE

SCIENTIFIC SESSION

on

REGIONAL RESEARCH PROBLEMS

DR. C. J. MACKENZIE, Chairman

SCIENTIFIC RESEARCH AT THE UNIVERSITY OF SASKATCHEWAN

Address by

DR. W. P. THOMPSON

Dean of the College of Arts

As a member both of the National Research Council and of the faculty of this University, I am naturally hopeful of the intellectual cross-fertilization which should take place between the staff of this new laboratory and that of the University. It is an elementary principle of the subject which I teach that cross-fertilization between different varieties produces offspring of great vigour, which we call hybrid vigour. As a matter of fact we shall have here a kind of triple hybrid because the Federal Department of Agriculture has several research laboratories on our campus housed (very inadequately) in our buildings: entomology, plant pathology, soils, forage crops, and agricultural economics. We may, therefore, look forward to very vigorous results.

In addition to the work of the Research Council's own staff, it was thought that we should have at this meeting some account of a sample of the work which the Council supports outside its own laboratories. Few people, even among those who are engaged in it, have any idea of the extent of the work which the Council supports and stimulates in the universities all across Canada. I am, therefore, to make a short statement about that sample of the work which has been done and is

being done at this University. Nearly all of it has been supported, at least in part, by the Council.

It will be possible in the available time only to indicate the general nature of the research projects. The men who have carried them on or supervised them have been asked to be in their laboratories tomorrow, and will be glad to explain them in detail to any who are interested.

I must apologize to those of my colleagues whose work I do not mention or to which I do not give the emphasis which it deserves. I can only plead the limitations imposed by time and my own ignorance. It will have to be a sample of a sample.

AGRICULTURE

(a) *Plant Breeding*

An important part of our agricultural research has been the production by breeding methods of new and improved varieties of crop plants suited to our conditions. In this connection one should mention the rust-resistant wheat, *Apex*, which now occupies a good deal of the wheat land of the province. The solution of the rust problem is a fascinating story which can't be told here. But it should be pointed out that it involved a great deal of basic work on chromosome conditions and behaviour, sexuality in rusts, rust strains, and their origin, differentiation and distribution, the nature of resistance, etc. In all this work the Department of Agriculture and the Research Council, through the universities, co-operated. In fact it is an ideal example of a co-operative enterprise. The Departments of Biology and Chemistry, as well as Field Husbandry, in all three prairie universities, played their part.

Other new varieties produced here include the successful Royal variety of flax, and new types of oats and barley. Those interested in this work should see Professor J. B. Har-

rington in the Field Husbandry Building. In forage crops, too, there is for example the famous Crested Wheat Grass which was originated by Dean Kirk. That type of work with forage crops is now being carried on in a laboratory of the Dominion Department of Agriculture located on this campus.

(*b*) *Plant Ecology*

A large amount of highly-regarded work has been carried out on the root systems of plants and applied in the control of weeds. This work by Professor Pavlychenko was long supported by the Research Council.

(*c*) *Soil Surveys*

The work of the Soils Department on the classification of soils, based on soil morphology and soil genesis, has become widely known. The Soils Department is now in the Chemistry Building but is to occupy one of the new buildings which you see going up on the campus.

(*d*) *Animal Diseases*

The Veterinary Department has concentrated its re-research on virus diseases of live stock. Notable results have been successful vaccines for equine encephalomyelitis and contagious ecthyma of sheep. The former is produced in very large quantities in the University laboratory for use by Saskatchewan farmers. A new laboratory, specially designed for virus work, is now being built and has special features in which some of you may be interested.

(*e*) *Dairy*

The Dairy Department under Dean Graham has worked chiefly with the bacteria, yeasts and moulds which affect the dairy industry.

BIOLOGY

In biology we have been active in four main fields: genetics, fresh water biology and related fisheries, entomology, and plant pathology.

In *genetics* a good deal of the work has been on chromosome behaviour in species crosses and its relation to sterility and breeding results. At present Dr. Arnason is securing some very interesting results in producing mutations and chromosome aberrations by feeding radioactive substances to plants. This is being done in collaboration with Dr. Spinks of the Chemistry Department.

In *fresh water biology and related fisheries* Dr. Rawson has done much work in the lakes of all four Western Provinces. During the last two years he and a large party of assistants have investigated the biology and fisheries of Great Bear and Great Slave Lakes in the Northwest Territories. This work has been supported by the National Research Council, the Fisheries Research Board, and the National Parks Branch.

We have always been strong in work on *plant diseases* through the presence on our staff of the late Professor Fraser, a pioneer in work on rust of cereals, and of Canadian plant pathology in general. His work is being continued by Professor Vanterpool, who is now concentrating on diseases of flax.

In *entomology* we have a recognized authority on mosquitoes in Dr. Rempel. He has also done much work on other blood-sucking insects particulary in relation to their possible role in transmission of encephalomyelitis.

CHEMISTRY

In my ignorance of chemistry the best I can do is to quote from a modest statement prepared by the Head of the Department for another occasion: "The following might be mentioned as fields in which research has been carried on here: chemical kinetics and photokinetics, phase equilibria, thermochemistry and hydrothermal reactions in the solid state." The outstanding work of Dr. Larmour in cereal chemistry is well known to everyone connected with the Research Council

and is being continued by Dr. Spencer. The work of Dr. Spinks with radioactive isotopes, both in pure chemistry and in agricultural and biological applications is also known to most of you.

PHYSICS

The Physics Department has been particularly noted for research in atomic and molecular spectra. We lost an outstanding authority in Dr. Herzberg and are glad to know that he is returning to Canada and to the service of the National Research Council.

A second division of physics in which our department has been active is geophysics and meteorology. The work has dealt with the physics of the atmosphere, electrical charges and falling and drifting snow and many problems peculiar to the climate and meteorology of the Prairie Provinces and Northwest Territories.

At present our physicists are greatly excited about their new betatron donated by the Atomic Energy Commission. We had hoped that it would be in operation by the time of this meeting, but unfortunately, although it is completed, it still has to undergo certain tests. The new building to house it, donated by the Provincial Government, is completed and may be seen behind the Physics Building.

ENGINEERING

Our engineering research is concerned mostly with housing under Dr. Hutcheon, who is working in collaboration with Mr. Legget of the Research Council; with new developments in farm machinery under Professor Hardy; and with the location and testing of clays and non-metallic minerals by the Ceramics Department.

Since at present the University is staffed and equipped to give only pre-clinical work, medical research has been in the basic medical sciences. Professor Altschul's recent work has been in nerve repair, experimental arteriosclerosis, and muscle degeneration. Dr. Jaques in physiology and Dr. Collier in biochemistry have been working chiefly on blood.

RESEARCH IN THE DOMINION DEPARTMENT OF AGRICULTURE

Address by
DR. K. W. NEATBY
Director of Science Service
Dominion Department of Agriculture

The purpose of this address is not to review well known research accomplishments of the Department, but to consider briefly one or two problems of organization and administration with particular reference to Science Service.

The work of the Dominion Department of Agriculture must, and does, cover a wide range of activities including 'pure' and 'applied' research, demonstration, information, inspection and control-testing connected with legislative enactments. The demands for information and for a wide variety of services are heavy and cannot be fully met. Senior officers responsible for investigational work are almost constantly confronted with the problem of meeting demands for specific services and, at the same time, of maintaining an essential, if inadequate, research programme without which the services in popular demand would soon suffer. The large measure of freedom allowed senior administrative officers in their attempts to achieve a sensible balance between service and research is a credit to the Canadian public and to the Government.

With the exception of economics, all research in the Department is concentrated in the two services, Science and Experimental Farms. The essential interlocking of many of the various phases of agricultural research complicates the problem of separation into appropriate administrative units, and co-operation at inter-divisional and inter-service levels is, regardless of what the administrative framework may be, absolutely necessary. Happily, collaboration between workers in the various divisions of both services is extensive and successful, though further extension would be beneficial.

One of the first questions confronting anyone responsible for the organization and administration of agricultural research on a national scale concerns centralization and decentralization. Agricultural enterprises are largely determined by conditions of soil and climate and these conditions vary enormously from one part of Canada to another. In many of the most important research undertakings, field and laboratory work must go hand in hand and must be conducted where the problems are encountered. Probably the most favourable opportunities for centralization are found in live stock investigations, chiefly because environments are much more subject to manipulation than are plant environments. The distinguished reputation enjoyed by the Animal Diseases Research Institute, Hull, Quebec, would undoubtedly be much less distinguished had the work been scattered through small laboratories across Canada. Branch laboratories are maintained only for essential regional services and problems requiring local attention. Aside from the obvious benefits derived from adequate laboratory facilities and specialized equipment, impossible to obtain in small scattered laboratories, the influence of highly qualified and skilled scientists is much greater in a large laboratory and the benefits of intimate contacts between scientists are assured.

In the Division of Chemistry most of the research can be and is, centralized. This is particularly pronounced with soils chemistry, animal nutrition and vitamin research. However, the demands by branch laboratories of other divisions of Science Service for co-operative work, and by various divisions of Experimental Farms Service, are becoming increasingly frequent and insistent.

The situation in the Division of Bacteriology and Dairy Research is essentially similar to that in the Division of Chemistry. The Division is responsible for researches on micro-organisms in soils and foods, particularly dairy produce, and necessarily becomes involved in considerations of the importance of antibiotics and the exceedingly complex interrelationships between various species characteristic of particular habitats. The work now in progress is centred chiefly in Ottawa; but expansion in branch laboratories of other divisions is long overdue.

The situation with respect to economic diseases and insects on farms and in orchards and forests is quite different. Although fundamental investigations on, for example, taxonomy, physiology and toxicology can be concentrated in large national or regional laboratories, most of the applied research must be carried out where the problems occur, and laboratories must be distributed accordingly. Diseases and insects of orchards must be studied in orchards. Wheat stem sawfly research must be conducted in the southern regions of Saskatchewan and Alberta. Nowhere in Canada are conditions so well suited to studies on cereal rusts as they are in the Red River Valley in Manitoba. Dozens, even hundreds, of other examples might be cited.

The appropriate exploitation of limited research facilities is a matter of concern to every scientist in the Department. In Canada over six hundred and fifty diseases of economic

plants, including ornamentals, are recognized. Two hundred and twenty-six are under active investigation; but the Division of Botany and Plant Pathology must be prepared to provide information on any one of the total number. To meet these demands, as well as to maintain essential taxonomic, physiologic and life-history studies of native and introduced plants, including fungi, the Division has a professional staff of one hundred and seventeen persons. Consequently, the Division as a whole, and every individual member, is influenced on one hand by a desire to complete, phase by phase, projects of scientific interest and economic importance and, on the other hand, by public demand for attention to a multitude of plant-disease problems.

The situation in the Division of Entomology is equally, if not more, complicated. At the present time, the Division is investigating between seven and eight hundred species of insects of economic importance, including those parasitic on species destructive to agricultural plants and forest trees. It is estimated that the total number of potentially important species, from the economic point of view, amounts to several or many thousands. The present programme of research on taxonomy, life histories, physiology, toxicology and control methods, as well as providing available information on any economic insect, is carried on by a professional staff of just over two hundred. Probably without exception these workers realize that the 'applied' problems with which they are expected to cope could be dealt with much more effectively if the more fundamental aspects of entomological research could be given due weight. Much creditable research is in progress and its acknowledged inadequacy is directly attributable to the insistent demand for practical control methods of immediate, if limited, use and for information.

Few of the problems with which the agricultural scientist must deal are susceptible to final solution and new

ones continually arise. Insects are notoriously adaptable and parasitic fungi are anything but stable. The wheat-stem sawfly is native in Canada, but adapted itself to cultivated wheat with conspicuous success. Only recently the flax bollworm extended its host range from native species of *Linum* to cultivated flax.

The biological and economic effects of adaptation on the part of destructive pests are essentially similar to those resulting from the introduction of new crops and new varieties of old ones.

An additional disconcerting feature from the agricultural scientists' point of view is the almost continual appearance of new problems not to mention the assumption of major importance by organisms traditionally innocuous or nearly so. Who in Canada, ten years ago, had heard of the potato-rot nematode, European elm disease, or the blight of oats caused by *Helminthosporium victoriae*?

We, in Science, believe that the most effective way to exploit what will always be, or at least seem, inadequate research facilities, is to recognize different categories or types of laboratories in order to avoid a mixture of research, experimentation, service and extension in all. Work than can be consolidated in large laboratories should not be scattered. The advantages are already manifest in the Animal Diseases Research Institute at Hull, Quebec, and the Dominion Parasite Laboratory at Belleville, Ontario. A second essential type is the regional research laboratory in which various specialists from any division can be assembled to work as a team. The advantages, indeed the necessity, of this type of laboratory are apparent in the Dominion Rust Research Laboratory, Winnipeg, Manitoba. An essentially similar establishment involving as in Winnipeg, divisions of Experimental Farms Service and Science Service, is now nearing completion in Lethbridge, Alberta. Lastly, and by no means least important, field labora-

tories will be maintained as heretofore to deal with local problems and services.

The necessity for recruiting and retaining able and well-trained scientists is perhaps too obvious to merit attention, at least so far as this audience is concerned. Without them the buildings are addled eggs. There are, and have been for many years, distinguished scientists in the Department. The almost unlimited opportunities for research are becoming more widely appreciated and despite the acute shortage of well-qualified workers, particularly in some fields, our standard is rising.

In conclusion, allow me, on behalf of the Department of Agriculture, to congratulate the National Research Council on the establishment of this laboratory. Undoubtedly it will exert a profound influence on workers in other laboratories and we welcome it and wish it well.

UTILIZATION RESEARCH IN THE NATIONAL RESEARCH COUNCIL

Address by
DR. G. A. LEDINGHAM
Director of the Prairie Regional Laboratory

The opening of the Prairie Regional Laboratory does not mean the beginning of utilization research in National Research Council laboratories. Rather, it is the continuation of work begun in the Division of Applied Biology when Dr. Newton was there as Director, and which has since been greatly expanded under the leadership of Dr. W. H. Cook. During the 1930's, Dr. J. A. Anderson and Dr. H. A. Sallans carried out intensive studies on the malting qualities of Canadian barley, a project which might be regarded as part of our utili-

zation work. In addition, Dr. Malloch's studies in cereal chemistry and Dr. Anderson's project on the chemical constitution of wheat plants should be mentioned.

The work with which I am most familiar, however, began just prior to the outbreak of World War II when the first investigations on industrial fermentations were initiated. Dr. G. A. Adams was appointed to carry on the biochemical phases of this work and my own laboratory undertook the microbiological studies. Our first project was a fundamental study on the decomposition of the lignosulphonic acid fraction of waste sulphite liquor by various species of soil fungi and wood-rotting fungi. These investigations were carried on for over a year, but after the outbreak of war it became necessary to lay this work aside and concentrate on more urgent war problems.

It is impossible adequately to review all of the different utilization problems which have received attention in the Division of Applied Biology during the past eight years, but I should like to mention those which will still be carried on or expanded in the new laboratory opened today. In several fields wheat was our basic raw material. It was used as a fermentation substrate in the 2, 3-butanediol studies and much attention was paid to separation of starch and gluten, and the manufacture of syrup from wheat starch. While these studies on wheat were being carried out in Ottawa, the Division was also interested in fats and oils. Much of the wartime research was concerned with edible fats and the research was therefore carried on in the food section of the Divison or under the Associate Committee on Grain Research. Dr. Sallans and his group in Saskatoon worked under this Committee until their recent transfer to the staff of the Prairie Regional Laboratory.

After Pearl Harbor and the entry of the United States into the war, shortages of many different materials began to

appear as war production got under way. At that time you will recall we had an enormous surplus of wheat in Canada. All the elevators were clogged and huge storage bins had been built at many points. The question was frequently asked, "What can we use wheat for besides making bread?" One of the most urgent production problems of the moment was the manufacture of synthetic rubber. For its synthesis enormous quantities of butadiene were urgently required. There were various ways of arriving at this chemical and one of the simplest methods was obviously from ethyl alcohol by a catalytic process. However this process was still in the experimental stages and it seemed worthwhile to attempt synthesis through other routes. The butanediols had been suggested as possible precursors since chemically they are closely related to butadiene. It was known that 2, 3-butanediol was a fermentation product and might be produced by different bacteria. However the fermentation was then only a laboratory curiosity, far from a practical industrial process. Hence we proposed to undertake a study of this relatively little known fermentation. About the same time work was started in the United States and we were asked to join a Committee which met at the Northern Regional Laboratory in Peoria. The work on the production of butanediol thoroughly initiated the Division of Applied Biology into the field of industrial fermentations. After a few months of laboratory study a pilot plant was designed and built for the production of this chemical on a larger scale than laboratory facilities would permit. In the meantime our staff had been greatly expanded by the addition of Dr. R. Y. Stanier and Dr. K. A. Clendenning, Dr. A. C. Neish, Mr. J. D. Leslie, Mr. A. C. Blackwood, and several other workers.

More than 25 scientific papers have now been published in our series on "The Production and Properties of 2, 3-Butanediol". The most detailed studies were made on the

fermentation of wheat mashes with *Aerobacillus polymyxa*. Numerous strains of this organism were isolated and tested for their potential butanediol production; factors affecting the fermentation such as aeration, pH of the medium, temperature, and numerous other details were investigated. In the pilot plant both wheat and barley were evaluated for use as fermentation raw materials; several systems of recovery of the diol from fermented mashes were tested. The necessary production techniques for a full-scale industrial plant are now known and data for the design of a modern plant are available.

Because 2, 3-butanediol is a relatively unknown compound, every opportunity has been taken to study its possible use as an industrial chemical. Dr. Neil and his associates have investigated esters of the different stereoisomers. They have also studied the dehydrogenation of 2, 3-butanediol by copper and nickel catalysts for the production of acetoin and diacetyl. Dehydration of this diol by sulphuric acid was shown to give its methyl ethyl ketal. Following these studies acetals and ketals using 20 or more ketones and aldehydes were prepared, and their properties described. In addition to these duties Dr. Grace and Dr. Watson have studied the production of polymers resulting from interaction with various organic acids or anhydrides.

The most obvious direct use for 2, 3-butanediol appeared to be as an antifreeze fluid. Dr. Clendenning undertook studies in this field and evaluated its properties in comparison with other commercial antifreeze solutions. It was found that aqueous solutions containing 50-60% of *levo*-2, 3-butanediol are suitable for use as winter radiator fluids and that there are no serious objectionable characteristics. With the exception of slightly higher viscosities at low temperature, it compares very favourably with ethylene glycol in respect to its antifreeze properties.

Leaving the fermentation field I should like to turn to the other major project involving industrial uses for wheat. This was the development of a continuous process for the separation of starch and gluten. Before the butanediol project started, Dr. Adams, Dr. Grace and myself had spent several months developing mechanical procedures for washing the starch out of wheat flour. A batch process which involved washing a stiff flour dough was developed which gave 95-97% total starch recovery. This process was not directly amenable to large-scale commercial operations, but Dr. Adams and Mr. Shewfelt later solved the problem of continuous separation by devising a "batter process". Patent flour is mixed with 80% of its weight of water to form a soft dough. By agitating the dough in 10 times its weight of water the starch is almost completely removed from the gluten which accumulates in the form of small curds. The two fractions can then be readily separated by passage over a vibrating screen. The process as finally worked out and put into pilot-plant operation was found to be continuous, simple, and well adapted to industrial application. Recently Dr. Adams has investigated the problem of drying the gluten so as to retain its native properties. This project is now nearing a successful conclusion. As a result of this work the foundation for a wheat starch industry has now been laid in Canada. Several commercial plants have been operating during the past few years and it is hoped that the industry will continue to expand.

While the starch—gluten separation studies were being made, Dr. Clendenning undertook fundamental studies on the determination of wheat starches in cereal products. He investigated the current methods for measuring starch and developed improved techniques. His method has recently been adopted by the American Association of Cereal Chemists for starch determination in cereal products.

Following these studies, Dr. Clendenning investigated the manufacture of glucose syrup from wheat starch. Small pilot-plant equipment was installed and a comprehensive study was carried out which showed that excellent, high quality, clear, wheat syrup can be made from wheat starch.

About 1940 it became obvious that a great deal of work would be required in connection with fats and oils. These were in great demand and it was necessary to expand the production of flax and also to try to substitute other oils wherever possible for those which we had formerly imported from the Orient. Sunflowers were introduced as a western crop for oil production, and later rapeseed. The growing and processing of rapeseed for oil production has now become quite an important industry in the West. Rape is ideally suited to the Park Belt land of Northern Saskatchewan and several thousand acres of rape are now being grown annually. In 1941, Dr. Sallans with his assistants set up a laboratory in the Chemistry Department, University of Saskatchewan: he has done a great deal of work on the determination of oils from different flax varieties as well as sunflower and rapeseed. He has co-operated with plant breeders at the University, making determinations on their varietal selections. Much more work is needed, particularly on rapeseed oil, to determine the different fractions and study the potentialities of these for industry. Better methods of separating oil fractions are needed and these must be assessed for making various chemical derivatives. This work will be expanded and carried on in our new laboratory.

The foregoing gives a very brief description of some of the work which was carried out in the Division of Applied Biology. It soon became obvious that if the question of industrial uses for agricultural crops was to be tackled on a systematic broad scale, further facilities would be necessary. These have

now been provided in the Prairie Regional Laboratory. I would like now to outline briefly some of the plans we have for further studies in this laboratory.

You will have noticed on your tour through the building that there are eight separate research laboratories, each with three or four offices or service rooms at the ends. Our present plans are to allot the work which we are going to carry out as follows:

On the first floor, one laboratory will be devoted to oils and fats research. Across the hall from it will be a protein laboratory. At the other end of the building, one unit will work on carbohydrate chemistry, specializing in starches and sugars. Across from this will be the agricultural residues laboratory in which work on cellulose, hemicellulose and lignin will be pursued. In this way we will have one floor of the laboratories working on practically all the basic constituents of plants.

On the ground floor will be the laboratories for industrial fermentations and microbiology. At the east end a unit will be assigned to mycology, and across the hall one to bacteriology. The two units at the other end will deal with biochemistry, one specializing in the major fermentation products, the other on enzymes, vitamins and antibiotics. Actually these subdivisions are not clear-cut and there will be many studies which will need the co-operation of one or more of the different units.

At the present time we have staff appointed for starting three main research projects. First is the continuation of the work that Dr. Sallans has been doing on fats and oils. Another project on agricultural residues will be started, and to begin with we plan on the manufacture of building materials from straw. Finally, studies on industrial fermentations will be

undertaken. Dr. Neish has already arrived from Ottawa to set up the biochemical laboratories, and Mr. Blackwood, now at the University of Wisconsin finishing his graduate studies, will be here in October to take charge of bacteriological phases of the work. Dr. Haskins, now studying at Harvard University, has been appointed as our mycologist. He should be here by November.

Time is not available to give more than a very brief outline of the problems we hope to underake at present. In fats and oils, Dr. Spencer of the University Department of Chemistry is taking over part of the routine testing work for new varieties that Dr. Sallans has been doing. In our laboratories, Dr. Sallans and his associates will now install a solvent-extraction column and undertake separation of some of the major constituents of oils. Rapeseed oil in particular will receive considerable study and it is also planned to test the possiblity of fractionation of the oil by crystallization at low temperatures. Dr. Grace, who works in close co-operation with the food group at Ottawa and has the benefit of the taste-panel laboratories, will undertake the main studies on food uses for rapeseed oil. Dr. Sallans' work will be largely confined to new industrial uses, after he has carried out some of the basic work on separation of the different constituents.

Under "agricultural residues" we hope to investigate the manufacture of building boards of different types from wheat straw. The straw problem still exists on the prairies, although the combine has greatly changed it from the early days when large straw piles were burned each year. The question of collecting straw still remains to be solved, although new types of balers are being developed which may eventually bale the straw as it is cut. The whole problem of the optimum amount of straw which should be returned to the soil to keep it in good condition needs further investigation. We hope to

co-operate with the soils group here at the University on this problem. It will carry us into the field of the decomposition of straw and some of the products found in the soil, also studies on the effect of these on subsequent crops. When it is known how much straw can safely be taken from the fields to be used in industry, we will be in a much better position to assess the available supply. There are certain districts, especially in the north, where very heavy yields of straw occur almost every year.

At the Northern Regional Laboratory in Peoria, Illinois., they have developed an excellent building board somewhat like "Ten/Test" from pulped straw. The Building Research Division in Ottawa is now undertaking several projects on building materials. One of these will be carried out here in co-operation with university staff. The refrigeration rooms which are necessary for the low-temperature testing of building materials will be installed in our building. It is hoped that the building research group here will be able to give us direction for the manufacture of suitable boards with the necessary strength and insulation properties. Much of the work in this project can best be done in a pilot plant. Some of the equipment has already been ordered and we hope to proceed in the near future with the installation of cookers, board formers and a heavy-duty press for forming boards.

Along with the pilot-plant studies in the residues work, it is hoped that there will be an opportunity to start laboratory experiments on the separation of hemicellulose, cellulose, and lignin from straw. We are also interested in the conversion of cellulose and hemicelluloses into glucose and pentose sugars for use in our fermentation studies.

In connection with industrial fermentations, one or two projects begun in the Ottawa laboratories will be completed at Saskatoon. We will carry on with new industrial fermentations such as the production of glycerol and butanediol by

Bacillus subtilis and also the production of organic acids such as lactic and formic. At the present time we are importing large quantities of these into Canada from the United States and we should have methods of our own for their production. One of the major raw materials for use in fermentations here in the West will of course be the cereal starches. If we are to ferment these with organisms, they must first be converted into glucose. This can be done either by acid hydrolysis, by the use of barley malt, or by enzymes from various micro-organisms. This latter field has been developed rapidly in recent years. During the war when malt was in short supply the shallow-pan process for the production of amylase became an important industrial process in the United States. At the University of Nebraska a great deal of work was done using *Aspergillus oryzae* which is grown on bran in shallow trays. Lately a more promising process, which involves growing *Aspergillus niger* on distillers' solubles in deep tanks for the production of amylase, has come into use. The work on this problem is still only in its infancy and we hope to take it up and determine whether a satisfactory process can be developed. We plan on starting this investigation during the coming winter so that the process will be available for use in future pilot-plant investigations.

During the past year in Ottawa we developed, in co-operation with the Radio Division, a new automatic pH controller. You have had an opportunity to see this equipment in our exhibit. Although the work with it is only starting, we have greatly shortened the fermentation time for several butanediol fermentations. However, only two or three organisms have so far been studied and there is much new work still to be done using other alkaline bases for the neutralization of the acids formed, and testing many different types of micro-organisms under carefully controlled conditions. The numerous types of micro-organisms, especially in the fungi, have

scarcely been touched from the standpoint of fermentation chemistry. We hope to investigate many new species. It will be part of the work of the mycology and bacteriology laboratories to isolate, classify, and test many different strains. In addition to this, the development of modern techniques such as X-rays and ultraviolet irradiation for the production of different mutants should not be overlooked. Here in Western Canada one of the best uses that could be made of wastes or surplus agricultural materials would be to enhance their animal-feeding value. It is now possible to produce large quantities of vitamins such as riboflavin by fermentation processes. These ought to be investigated, especially for the improvement of different feeds which are being sold at the present time. It is also possible through fermentation to convert carbohydrates, which are the chief constituents of most crops, over to proteins or fats and oils, should the need arise. These conversion processes need further study in order to assess the potentialities.

The foregoing summary of our plans for research must be regarded as somewhat tentative since it is often difficult to foresee the future in regard to research. If we start down several avenues, however, these are sure to branch into unpredictable and, let us hope, profitable sidelines. I hope, sometime in the future after the laboratories are in operation, that we may have the opportunity of holding a utilization conference to discuss these research projects in greater detail.

BUILDING RESEARCH

Address by
MR. R. F. LEGGET
Director of the Division of Building
Research, National Research Council

Agriculture and building were probably the two first organized activities of man. It is a nice question to consider which of the two came first, but not an appropriate one for today since the proceedings here centre definitely around agricultural research. Building has, however, been so closely associated with all agricultural endeavour that it may not be inappropriate for building research to be featured in a minor capacity on this interesting programme. In one respect there can be no question as to the priority of the two subjects, and that is when thought is given to the application of laboratory research to agriculture and to building. Something of the development of laboratory research in association with agricultural work in Canada has already been described to the meeting. The record is an impressive indication of the importance which scientific research already occupies in this general field. On the other hand, laboratory research on building techniques has lagged far behind similar activity in agriculture. It is therefore not unfitting that the Building Research Laboratory associated with this Regional Laboratory of the Council should be a single room tucked away in a basement!

Although the record of building research, as carried out in laboratories, is not an extensive one, much has been done in many of the specialized fields of building (thus being described by names other than "building research"). Much fine research work has been done far from laboratories on actual building jobs. In this place it is proper to remind ourselves of the outstanding work of Dr. Thorvaldson in his studies of the effects of alkalies on concrete and his connection with

the development of alkali-resistant cement. Many here present will remember the pioneer work of Professor Greig in the early twenties, when he erected on the campus of this University the first building test-huts to be used in Canada, thus initiating the splendid studies on insulation and heating which are still being continued.

Without his permission, but very gladly, I record also the excellent research carried out by Dr. Mackenzie in connection with his outstanding work on the design and construction of your own Broadway Bridge. His investigations of the settlement of the piers of that bridge constitute a remarkable piece of building research work. Finally, it is a special pleasure to acknowledge and to invite your attention to the building research work currently being carried out in this University by Dr. Neil Hutcheon and the fine group of young men working with him in the Housing Research Centre of your own College of Engineering.

These examples of building research, all taken from this vicinity, will show you what a broad field is combined by the now generally accepted title of "Building Research". It is an extension and development of such work that is the responsibility of the newly formed Division of Building Research of the National Research Council. In view of the work which has been done here in Saskatoon, it is appropriate that our first Building Research Laboratory should be located here in the Regional Laboratory Building. We follow in a good tradition and will try to be worthy of it.

A similar story of the steady development of the application of research to building problems can be told for other parts of Canada, and indeed, for many other countries. The construction and building industry now ranks as the second or third most important in the Dominion. It is not surprising, therefore, that the National Research Council should have

recognized the need for integrating the research work already being done in Canada in this field and for an extension of this work, this appreciation having led to the setting up of the Division of Building Research something less than a year ago.

The Division is therefore "the baby" of the Council in every sense. In view of the current volume of construction the recruiting of staff is proving to be singularly difficult, so that "the baby" is a very puny child indeed. Puny as it is, its eyes are at least open, and as they look ahead three sign-posts can be clearly seen. These we hope to follow.

In the first place, building research must always be a judicious combinaton of laboratory investigation and studies carried out right on the construction job. This blending of the scientific and the practical alone can give results which will be of value to the industry. In the second place, co-operation with other organizations interested in the various specialized aspects of building research is an obvious requirement in order to avoid unwarranted duplication of effort and to ensure the full use of the information on good building practices which is already available. In the third place, building research in Canada is being considered from the start of the work of the new Division on a regional basis. The Maritime Provinces obviously constitute a region in this sense. British Columbia similarly presents its own problems. In the far North of Canada, we have a vast area which presents building problems peculiar to the Dominion. Ontario and Quebec form a logical unit in this respect. Finally the three Prairie Provinces are alike in regard to the building problems which they present.

It can readily be seen that each of these regions presents special local building problems, which, while they can and must be co-ordinated, must also be studied locally. Climatic differences are an obvious determinant, perhaps the major one. Different building materials, however, are available in varying

supply in the several regions. Soil and foundation conditions naturally vary tremendously across the country. Local building requirements must always be considered in relation to building research work. Here on the prairies, for example, the building problems of farm structures are pre-eminent, as indicated by the existence of the Prairie Rural Housing Committee operated jointly by the three provinces and Central Mortgage and Housing Corporation, with which the Division of Building Research has a very close working understanding. Finally, if building research in Canada is to be fully effective, it must be carried out with the support of local interest and in close association with local building operations.

It is a great pleasure, therefore, to be able to state that, even at this early stage in the development of a new Division, we look upon the laboratory facilities which we are privileged to have here on this campus, as the beginning of the Prairie Regional Organization of the Division. We look forward to working with Professors Macdonald and Russell of the University of Manitoba, with Dean Hardy and his staff from the University of Alberta, and with Dean Spencer, Dr. Thorvaldson, Dr. Hutcheon and their staffs here at the University of Saskatchewan. It is encouraging indeed to know that so much has already been done in the field of building research in the Prairie Provinces. All that we can hope to do, therefore, is to attempt to support this existing work and encourage its extension to meet still better your local needs.

Against this background you may not now find it so strange that the Division of Building Research is associated so closely with the Division of Applied Biology, in connection with a fine new building which was opened this morning and in other ways. Through the kindness of my colleague, Dr. Cock, we are to be privileged to use one of the splendid laboratories in the basement of the building. Here will be located

the first large-scale test chamber for the investigation of the thermal and vapour-resistant properties of complete wall structures (measuring up to seven feet by eight feet) under completely controlled conditions. This will be operated under the direction of Dr. Hutcheon and should be available next year for the solution of pressing problems in wall construction which are of such unusual importance in construction work on the prairies.

You will agree, I think, that it is significant that this first Building Research Laboratory is being opened in Saskatoon and not in Ottawa, a sure indication of our intentions with regard to regional operation. It is significant also that this laboratory is opened in association with another Division of the Council, that concerned with the utilization of agricultural products.

While the laboratory in itself is necessarily small, I venture to suggest in closing that it can be regarded at least as an example of the keen interest of the National Research Council in your local problems here in these three Prairie Provinces, and of the desire of the Council to extend its work of scientific investigation and study into yet another human activity which can be traced back to the beginning of history.

NATIONAL RESEARCH COUNCIL DINNER

DR. C. J. MACKENZIE, Chairman

Address by

DR. ROBERT NEWTON

President of the University of Alberta

No great project ever comes to fulfilment without a substantial background of preparation and development. The Prairie Regional Laboratory is the culmination of a long history of co-operation between the National Research Council, the universities of the Prairie Provinces, and the departments of agriculture, especially the Dominion Department of Agriculture. Its origins really go back to the beginnings of prairie agriculture.

The first settlers found that there were problems peculiar to this region which required investigation on the spot. The Dominion Department of Agriculture established branch experimental farms, which secured answers to a number of pressing questions. Some problems baffled them, for example, wheat rust, always a source of substantial loss, sometimes attaining the proportions of a major disaster. The battle of science with wheat rust became a model for campaigns in the field of agricultural science.

With the founding of provincial universities, the staff of these institutions interested themselves in the research problems of their communities. Dr. W. P. Thompson, of the University of Saskatchewan, began in 1915 to breed wheat plants better adapted to this new environment. In 1916 he observed that two varieties, an emmer and a durum, showed resistance to rust. He attempted to cross these with the bread wheats and soon ran into difficulties which led to his distinguished researches on the crossing of wheats with different chromosome numbers and patterns. In this work he had the

financial assistance of the National Research Council from 1917 onwards.

Following the disastrous rust epidemic of 1916, the late Dr. Walter C. Murray, President of the University of Saskatchewan and convener of a Special Committee of the National Research Council on Plant and Animal Diseases, initiated discussions with the late Dr. J. H. Grisdale, then Director of the Dominion Experimental Farms. The latter called a conference at Winnipeg in August, 1917, which formulated a plan of attack.

It is interesting to notice how accurately the scientifically trained men present indicated the methods which would lead to success. The late Dr. A. H. R. Buller, Professor of Botany at the University of Manitoba, emphasized the role of the barberry, which his student and follower, Dr. J. H. Craigie, was to elucidate so completely. The late Professor W. P. Fraser who, shortly before the conference, had been appointed by the Dominion Experimental Farms to be Officer-in-Charge of Rust Investigations, with headquarters at Brandon, urged the co-ordination of field observations with greenhouse and laboratory investigations, a method which eventually enabled his student, Dr. Margaret Newton, to unravel that other aspect of the rust organisms' complexities, the existence of numerous forms, some attacking certain wheat varieties and not others. Finally, Dr. W. P. Thompson proposed the breeding of wheat varieties for resistance to rust, an idea then so new that it was received almost in silence, Professor Fraser being the only member of the conference to comment favourably.

But it was to take still another epidemic, and more vigorous speechmaking, notably by Dr. H. M. Tory after he became chairman of the National Research Council in 1923, before these highly competent scientists were given adequate backing in their unequal struggle. In 1924 the National Re-

search Council, in co-operation with the Dominion Department of Agriculture and the prairie universities, established the Associate Committee on Cereal Rusts. This mobilized all the existent forces, and reinforcements were soon forthcoming. The Dominion Rust Research Laboratory was opened the following year on the campus of the University of Manitoba, with plant pathologists and plant breeders working side by side. By this time, too, Dr. J. B. Harrington had entered the field of practical wheat breeding at Saskatoon, thus leaving Dr. Thompson free to concentrate on the theoretical aspects of the work.

In 1926 another committee was initiated by the National Research Council, namely, the Associate Committee on Grain Research. The immediate object was to investigate the drying of tough and damp wheat, but the action had the very important effect of mobilizing the cereal chemist in an organization which has continued ever since to be the official body for testing the industrial qualities of grain, especially the milling and baking qualites of the many new rust-resistant wheat varieties. (Among the men enlisted by this Committee was Dr. R. K. Larmour, of the University of Saskatchewan, who eventually became the first Director of the Prairie Regional Laboratory.) Only a few varieties survived the rigorous quality tests to which they were subjected by this Committee, but the distribution of these few, beginning in 1936, brought to a successful issue this epic contest with Nature.

"Thatcher" wheat, a Minnesota production distributed in Canada on a limited scale in 1936, "Apex", a Saskatoon production, and "Renown", from the Dominion group at Winnipeg, the latter two distributed in 1937, are names that deserve to live in the agricultultural history of the West. When these varieties were approved by the cereal chemists in the early spring of 1937 (not without a good deal of argument, for these men are perfectionists) I remember quoting to Dr. L. H. Newman,

Dominion Cerealist, who was naturally much concerned about the showing of his protege, "Renown", this verse from the prophet Ezekiel (34:29): "And I will raise up for them a plant of *renown*, and they shall be no more consumed with hunger in the land . . . ." I believe he was quite impressed by such literal fulfilment of prophecy.

Meanwhile other diseases, notable foot and root rots and smuts of cereals, were becoming more menacing, and the Associate Committee on Field Crop Diseases was organized in 1928 to mobilize all existing resources in a concerted attack on a wider front. The Rust Committee soon merged with this new body, it being recognized that new varieties should be resistant not only to one but to all the important diseases afflicting a particular crop. By an elaborate system of disease nurseries and regional tests, varieties were produced which are good in agronomic qualities, such as disease resistance and yield, and also in commercial qualities, such as milling and baking quality in wheat, malting quality in barley, and oil quality in flax.

Thus came into being a little army of plant pathologists, plant breeders, and cereal chemists, which has gone on to victory after victory, "Rescue" wheat, a solid-stemmed variety originated by the Dominion Plant breeders to beat the sawfly, is one of the most recent triumphs.

With the opening of the National Research Laboratories at Ottawa (itself a gradual process culminating in the occupation of the new building on Sussex Street in 1932) there developed almost immediately a pressure, increasing as time went on, for the establishment of a regional laboratory in the Prairie Provinces. We of the Council and its staff recognized very fully that there were regional problems which could be more effectively investigated on the spot. It is fair to point out that the Division of Biology in the Ottawa laboratories was at

the outset almost wholly occupied with projects of special interest to western agriculture. This seems natural enough when we remember that the initial staff of the Division were westerners who had followed Dr. Tory and me to Ottawa.

A number of important projects had been initiated by the Council in the West before the main laboratories were opened. For example the development of a hardy breed of range sheep, combining satisfactory mutton and wool qualities, was centred at the University of Saskatchewan, under Professors Shaw and McEwen, with the laboratory tests of wool quality made by the Council at Ottawa. (I am speaking now only of parts of projects supported by the Council, and am not ignoring other co-operating centres, for example, the important sheep-breeding work at the Dominion Experimental Station at Lethbridge. Further, I am speaking only of agricultural projects, hence do not mention such important investigations as those of Dr. Thorvaldson, at the University of Saskatchewan, on the protection of concrete from deterioration in prairie soils.) The weed investigations, long supported by the Council in the West, had their most notable expression in Dr. Pavlychenko's studies at Saskatoon on the interrelation of weed and crop plant root systems.

Projects of special interest to western agriculture initiated in the Council's laboratories at Ottawa included studies on the malting quality of barley; studies, mainly on the theoretical aspects, of breeding a large-seeded perennial forage plant suited to the drier parts of the prairie; crossing methods for producing fast-growing shelter-belt trees; and the processing of various food products, especially bacon, the production of which on the prairies was growing by leaps and bounds.

We actually operated a small regional laboratory at Winnipeg for some years, the barley malting laboratory in the

University of Manitoba. Later that was taken over by the laboratory of the Board of Grain Commissioners.

In the summer of 1939, with the authority of the President of the National Research Council, I travelled through the West looking for accommodation for the beginnings of a regional laboratory of wider scope. Wheat surpluses were beginning to pile up (perhaps our rust campaign had been too successful!) and there was growing interest in the possibility of finding other industrial uses for agricultural surpluses of various kinds. I visited the universities to see whether the co-operative work the Council was doing with them might be expanded into a sort of decentralized laboratory. It has always been the policy of the Council to encourage the fullest use of existing facilities before undertaking to add new ones. But even then the universities were crowded, and only President Thomson volunteered to give me space.

Unfortunately the war supervened, and we were obliged for several years to limit our project to the oil seeds laboratory at Saskatoon, under Dr. H. R. Sallans, which is now absorbed in the new and larger organization. Meanwhile, Dr. W. H. Cook, who succeeded me at Ottawa, and his colleagues have made good progress in a number of lines, notably the separation of the various components of the wheat kernel and the fermentation of the starch to other useful products. The new laboratory therefore comes into being with a substantial background of preparatory work on a number of important projects.

A very important step in securing authorization for the construction of the laboratory was the holding of a conference at Saskatoon on November 3 and 4, 1943. This was attended by Dr. C. J. Mackenzie and Dr. W. H. Cook, of the National Research Council, Dr. G. S. H. Barton, Dr. E. S. Archibald and Dr. J. M. Swaine, of the Dominion Department

of Agriculture, and by a representative group of prairie agriculturists and administrators. There we heard reports with respect to the work to be done and the agencies available to do it, and after deliberating two days went on record as recommending the establishment of a prairie regional laboratory to supplement existing facilities. With this backing, Dr. Mackenzie lost no time in seeking authority to proceed, and this was soon forthcoming. War and post-war conditions delayed the completion of the building project, but as I indicated a moment ago, the organizaton and development of a research programme have gone ahead.

The situation has changed since the laboratory was first projected. Wheat and straw surpluses have disappeared, wheat because of world food shortage, and straw because of the advent of the combine harvester. Wheat surpluses may come again, and it is certain that other new problems will appear to tax the ingenuity of Dr. Ledingham and his colleagues. We leave the scientific future of prairie regional problems confidently in their hands.

So far my talk has dealt with the historical background of the Prairie Regional Laboratory. I should like now to glance for a few moments at a wider field.

Agriculture, whether of Canada as a whole or of the Prairie Provinces, must be considered in relation to other industries, existent or potential, and to the general economic and political situation.

The industrial age in which we live requires peace in which to function. It is marked by local specialization and mass production for world trade. In the eighteenth century, Britain represented the largest free-trade area, and there the industrial revolution began. More recently the United States wrested from Britain her industrial supremacy, having first

exceeded her in size of free-trade area, rich in natural resources and with the necessary population to develop these. Canada has the size and the resources, but so far lacks the population.

Canada's foreign trade in 1867-68 amounted to $120 million, or $34 per capita. By 1946 it had grown to $4,240 million, or $354 per capita. Only the United States and the United Kingdom surpass Canada in trading volume. Putting it another way, with 0.5% of the world's population, Canada has 7% of the world's trade. It is clear that, of all the countries in the world, Canada has the greatest stake in peace.

Economic war, as we know full well, can be only a little less disastrous than a shooting war. Economic nationalism is the fruit of fear,—fear of war and of being caught too dependent on other nations. With our overwhelming dependence on external trade, we are especially vulnerable, whether to the economic weapons of tariffs, quotas, and subsidies, or to the hot war weapons of military and naval blockades.

It is incumbent upon us to strengthen our position with all possible speed. We must develop our resources and build up a larger population. We need more industries, especially in the West. Our primary industry of agriculture would be greatly benefitted by the development of a better balanced economy in the Prairie Provinces. The larger population resulting from reasonable industrialization would provide not only local markets but better roads and schools and other amenities of life.

How to get these industries brings me back to the question of research. The large supplies of oil, gas, and coal, in Alberta particularly, represent power resources comparable to the potential hydro-electric power of the St. Lawrence waterway. They also represent industrial raw materials. We have much untapped water power of our own in the streams of the

Prairie Provinces, the development of which may often serve the primary purpose of irrigation and flood control. We have the agricultural wealth of the prairies in immediate contiguity to the mineral wealth of the Precambrian Shield. What we need is more people of the right sort, courage, imagination, and scientific research. Today we are dedicating another important link in the rapidly growing chain of agencies devoted to the task of sweeping away technical obstacles to the full enjoyment of our magnificent heritage.

I said a few moments ago that we must consider our position in relation to the political as well as the economic situation. Canada having the greatest stake in peace, must labour to secure a peaceful world. But appeasement has been discredited as a method of attaining that end. Preparedness, we hope, may prove a stronger weapon. At any rate, we must recognize that we live in a disturbed world, and must be ready to defend our freedom and our way of life.

The expression "industrial potential" is now a regular part of our preparedness vocabulary. Canada developed industrial potential in an astonishing way during the Second Great War. Scientific research goes one better as a fundamental and multiple weapon of both peace and war. First, it opens the way to industrial development which, if prosecuted wisely, can steadily improve our standard of living. Second, it creates industrial potential through this industrial development, since recent history has shown that soundly based industry can be rapidly expanded, or re-tooled if necessary for special war products. Third, scientific research itself, if well organized, can be expanded rapidly to meet the special needs of war. It provides one of the most important kinds of war potential.

It seems clear now that Germany was greatly handicapped in the last war by the regimentation of science.

Scientific research flourishes only in an atmosphere of freedom. It depends for its success on originality and initiative, qualities which cannot be made to order. It deals with facts and principles over which the will of a dictator can have no influence. One of the freedoms we must cherish is therefore the freedom of science.

Regimentation not only kills the spirit of science, but regimented or over-organized science is likely to be too much concerned with applied problems, neglecting the principle that knowledge must always proceed well in advance of its successful application. Scientists, like historians, must normally take the long view. In wartime we are forced to use up our stock of pure knowledge on practical applications of immediate urgency. In peacetime we must pay our debts and replenish our capital.

Finally, a word as to the researcher, the man himself. In spite of the ideal I have just expressed, I am afraid we must recognize that the researcher can no longer be left to secluded study and the single-minded pursuit of knowledge for its own sake. He has become largely the servant of the state and of industry, serving them for victory in war and for successful competition in peace. This is the mechanical age and the scientist is part of the machine.

That, you may say—and I agree—is putting the matter on its lowest plane. To seek power without responsibility, or industrial supremacy without caring for the workers, would be to worship false gods. Science may be, and is, indifferent to morality, but the scientist cannot be so. He should be a citizen *plus*.

Science creates problems as well as solves them. For example: How can we use mass-production processes without dehumanizing the workers? How can we enjoy the potential

benefits of atomic energy without exposing ourselves to the risk of mass self-destruction? In other words, how can we use science and technology without being dominated by them?

It is partly a problem of education. In planning professional curricula, we must remember that science is not a substitute for history and literature, the fine arts, philosophy, or religion. Science can mould *things* nearer to our heart's desire. Education should mould men and women.

History is the story of living people. Some individuals exercise a quite disproportionate influence. If we make it our care to get hold of the best students in our high school, young men and women of character as well as ability, and give them all the education they can stand, regardless of their ability to pay for it, then we may become masters of our destiny and mould history.

Only in such a world can the beneficent work of research institutions such as the Prairie Regional Laboratory reach full fruition.

Address by
DR. W. H. COOK
Director of the Division of Applied
Biology, National Research Council

INTRODUCTION

In this address I hope to give you some indication of the immediate background of the Prairie Regional Laboratory, the matrix of technical problems that gave it birth, and relevant labours of the parent, since some of these will now become the responsibility of the new institution.

There is a clause in the Research Council Act that reads: "Researches, the object of which is to improve conditions in Agriculture."

Agricultural research falls into two main divisions: research concerned essentially with production problems, and research concerned essentially with the uses of agricultural products. Much of Canada's past scientific effort in this field has gone into research on production, and relatively little has gone into research on uses. The broad programme must be balanced, and this is why this new laboratory will devote most of its effort to the utilization of agricultural crops. If we are to come anywhere near matching the splendid contributions made to production research, such as the achievements of the rust scientists, a major effort must be made in the field of industrial utilizations. One sure way of improving conditions in agriculture is finding new uses for agricultural wastes, surpluses, and low-grade products.

These new uses may be of two kinds: for food, or for industrial purposes. Food uses have been, and will remain, the major outlet for Canada's agricultural production. Food use establishes the price of most agricultural products, so we must not neglect the possibility of adding value to our agricultural products through the production of high-grade foodstuffs.

Nevertheless, the industrial use of farm crops has contributed to our agricultural economy in the past. Some crops such as flax are essentially industrial crops and food crops have also been used industrially during the emergencies of war. Technically, it is quite feasible to convert many existing wastes, surpluses, and low-grade products to industrial materials, but up to the present the majority of these have been marginal or unfavourable from the economic standpoint. New technical developments, price advances for industrial materials, or an increase in population, may convert some of these marginal possibilities into economically sound enterprises within a reasonable length of time. The effective utilization of wastes is essential to our future agricultural economy.

Just how important a crop can be in the way of yielding cash for farmers through off-the-farm utilization is indicated by the United States' use of corn. More than 80 million bushels are being consumed in industry, and while this represents only 3% of the total grown, it constitutes 33% of the farmers' cash sales of corn, the balance being used mainly for feeding livestock. Similarly, industrial uses, if they are economically sound, can assist in diversifying agricultural production, extending the regions of production, and establishing new industries in Western Canada.

So much by way of introduction. I plan to give the rest of my address in historical sequence, divided into four periods: firstly, the Depression—and since this is a painful subject, I will not dwell upon it; secondly, the War Period, when shortages affected production of certain essential materials; thirdly, the Post-War Period, in which we are examining the possibility of making wartime and other new developments beneficial to Canadian agriculture; and finally, the Future, a somewhat speculative subject.

The Depression

During the world-wide economic depression that preceded the war, existing surpluses and depressed prices aroused considerable interest in finding industrial uses for farm products. The solution of this problem was not as simple as it was made to appear. Enthusiastic chemurgists sometimes substituted wishful thinking for facts, looked for the swift solution of economic problems in scientific laboratories, or considered laboratory discoveries the equivalent of commercial production. On the other hand, the chemurgy movement, in spite of its faults, did stimulate research—the essential preliminary to discovery and development of new uses for the products of agriculture.

As a large surplus of wheat accumulated, we began investigations intended to find an economic use for the surplus. We were engaged in this work when war was declared.

The War Period

The war period was dominated by shortages, and the specific shortages that led to heavy Divisional commitments were: rubber, corn, sugar, and fats.

When the Japanese cut off the supply of natural rubber, all possible ways of producing synthetic rubber had to be explored at once. Butadiene for the rubber programme was first produced from grain alcohol and later for economic reasons from petroleum. In the early stages another possible source of butadiene was considered—butanediol, a four-carbon compound that can be produced from carbohydrates by fermentation. The Division of Applied Biology was requested to investigate this possibility.

Wheat was used as the raw material because it is the most abundant source of carbohydrate in Canada. Suitable organisms (*Aerobacillus polymyxa*) for this fermentation were isolated and selected. This was followed by intensive laboratory and pilot-plant investigations in Ottawa, where we have the only pilot plant of its kind in Canada. Many technical difficulties were encountered both in the laboratory and pilot plant, but these were overcome. Today this fermentation is essentially equivalent to the alcohol fermentation with respect to time requirements, efficiency, and yield of product.

Early in the war, shortages of corn starch led to studies on separating the starch and gluten from wheat. Earlier procedures had been cumbersome and unsuitable for the continuous production of a maximum yield of high-quality starch. A rapid and continuous method was developed in the Division, which obtains from patent flour upwards of 90% of the starch,

with a protein content as low as 0.4%, and practically complete recovery of the gluten, with a very low starch content. The process was first worked out on a large laboratory unit and then scaled up to pilot-plant proportions. This method has been used by several Canadian plants, both during and after the war, mainly to obtain wheat-starch for syrup production.

During the period of sugar shortages, extensive studies were made in a small pilot plant on the conversion of wheat and other starches to syrups. Syrups made from wheat starch are almost indistinguishable from those of other starches, and no serious technical difficulties are encountered in its processing. At the time, new industrial plants were going into production and they were able to utilize the information made available by the Division. During this period, about 1000 tons of syrup per month was produced in Canadian plants, mainly from wheat.

During the war, imports of vegetable oils for shortening manufacture were sharply reduced and, on the other hand, exports of cheese and butter to our allies were greatly increased. Canada's fat shortage, as you know, was met in part by growing larger quantities of flax, sunflower, soybeans, and rape. The Divisions at Ottawa, the Oil Seeds Laboratory here at the University, and the Ontario Research Foundation have all worked co-operatively on these problems. Shortages of edible fats resulted in studies on the possibility of converting linseed oil for edible use. Several million pounds were used during the emergency, but the problem was not solved completely. Processing can eliminate the flavour, but no suitable method has been found to prevent reversion to the linseed oil taste. In addition the Division undertook studies on Canadian lards and shortenings, and the information was supplied to the interested commercial firms. Studies on the preservation of butter were begun during the war period and have been continued.

THE POST-WAR PERIOD

In the post-war period, economic considerations rather than shortages dominate the picture. We have now to consider ways of putting wartime and other new developments to work in the interests of the agricultural economy. Specifically, the Division has so far studied the production of useful chemicals by fermentation, the utilization of residues such as straw, further work on oil seeds, and technical developments that may lead to a permanent wheat starch industry.

The war-produced chemical, butanediol, was found to have a number of remarkable properties. The *levo* isomer produced by *Aerobacillus polymyxa* is a good permanent-type antifreeze,—almost as good as the ethylene glycol of commerce, to which it is chemically related. But the main interest in butanediol lies in its versatility as a raw material for other chemicals. A large number of cyclic acetals, ketals, and sulphites have already been prepared, as well as ethyl methyl ketone, acetoin, and diacetyl. Butanediol is very reactive and it has been used to produce a number of polymers and resins; among them the butanediol-*o*-phthalate. Many of these products are new substances, and their possibilities for commercial use—as solvents, fuels, or raw industrial materials—have yet to be evaluated.

The utilization of crop residues should increase cash returns to the farmer and have a favourable effect on agricultural production and consumption. Most residues such as straw are chemically quite similar to wood and consist primarily of cellulose, hemicellulose, and lignin. Some investigations have already been made in Ottawa on the paper-making qualities of various straws. Roughly one-third of dry straw is cellulose and another one-third is hemicellulose. A laboratory procedure has been developed that removes the lignin but leaves both the celluloses, the combined fraction being known

as holocellulose. The use of this procedure would essentially double the yield of paper-making pulp from straw. The papers prepared from this material are of a glassine or parchment type and have a low density compared with wood pulp paper. This is a desirable feature for some uses. They have a relatively low tear resistance, but the other physical properties are satisfactory. Papers of this type have been prepared from wheat, oat, and fibre flax straw, and from flax shives.

Paper plants based on straw will probably not come into existence for some time. However, they are a distinct possibility, because our timber reserves are being depleted and the cost of wood pulp tends to rise accordingly. At the moment, special straws for the manufacture of special papers appear much more attractive. The Howard Smith Paper Company is now using straw from linseed flax for the manufacture of cigarette and other specialty papers and paying $8-$10 per ton at their plant in Winnipeg.

Because of the world shortage of fats and oils, a wartime study was continued on the extraction of oil fractions from waste weed seeds, for both edible and industrial use. Taste-panel tests have indicated that acceptable salad oils, mayonnaise, pastry, and doughnuts can be prepared with rape and even mustard seed oils. Acids prepared from these oils are being sulphated, and some are being subjected to high-pressure hydrogenation. Many esters and other products are being prepared and examined. Among the newer techniques used in preparing the fatty substances of commerce are the continuous butter-making machines. We are investigating the Fritz process in Ottawa. This machine can produce 1000 pounds of butter per hour from 45% cream.

Starch is required for a number of industrial purposes and also for the manufacture of dextrins, syrup, and glucose. For most uses, starch from different plants can be used inter-

changeably, and it is usually made from the cheapest raw material. In Canada, corn normally supplies most of the requirements, potatoes contribute a smaller amount, and wheat is used to only a minor extent. Although corn is generally cheaper and contains more starch, there should be sufficient low-grade material of a "starchy" type and second-rate flour to provide Canada's starch requirements. If wheat alone were used, about 5 million bushels would be required annually. Thus, it might benefit Canada's economy to establish a permanent wheat-starch industry.

If such an industry should develop, it would be helpful to make the gluten fraction as valuable as possible, and both starch and gluten should be recovered in the less perishable, dry form. Ways for doing both these things have been evolved, and we can now produce a gum or undenatured gluten by using a flash-drying procedure that converts the sticky gluten into a dry powder in less than five seconds. It is possible that this gluten may find an outlet in the food industry.

The Future

Basically, the Prairie Regional Laboratory will undertake studies on products and problems peculiar to the region it serves. These products are primarily agricultural and indeed are those that have received most attention during recent years in the Ottawa laboratories. It is evident that the offspring will inherit many of the investigations begun by the parent, and to that extent is off to a running start.

Work on oil seeds will be continued and extended to include pilot-plant developments. Vegetable oils are now valuable materials and attention will be given to methods of solvent extraction, since this removes the oil more completely than conventional pressure methods. Attention will be given to fractionation of the extracted oil to provide fractions more

suitable for edible and industrial use. The existing laboratory work can now be expanded to pilot-plant studies. Much background information must be obtained on these processes and the properties of the new western oil-seed crops such as rape and sunflower.

Straw is one of the common agricultural wastes in this region. Many feel it should be returned to the soil. This may be so, but until it is returned and proved effective, it remains largely a waste material. Industrially, it might be used as fuel, converted to paper, or made into a building material such as insulating board. Converting straw into briquettes for use as fuel might succeed as a farm enterprise and this possibility will be examined. It could hardly be developed into a substantial industry in this region where coal is cheap. I have alredy mentioned our Ottawa work on the possibilities for paper manufacture, and these studies can be followed up here at the Prairie Regional Laboratory.

The most attractive possibility for using straw appears to be its conversion into an insulating board. For this purpose practically all of the straw can be used, that is, a ton of straw should produce essentially a ton of building material. Insulating boards are light and at current prices per square foot represent a value in excess of 100 dollars per ton. In addition to being light, they should be rigid, provide a good surface for plastering, and be resistant to attack by bacteria and moulds. While the conversion of straw into this type of material is not simple, it offers one of the best possibilities for a western industry. If successful, it should yield the farmer a reasonable return, and provide a much needed building material at a reasonable price in Western Canada. No work has been done in Ottawa on this subject but the new laboratory will undertake studies immediately.

Industrial fermentations offer the widest possibilities for the economic use of surplus cereal products, waste materials such as molasses from sugar beet fractions, and, in fact, almost any waste or surplus material containing carbohydrates. The alcohol fermentation by yeast is one of the oldest, and has its industrial as well as its potable uses. But many products other than alcohol can be produced by bacteria or moulds. During the First World War, the butyl alcohol–acetone fermentation was developed industrially and made possible the first drying finishes on cars. During the last War, the butanediol fermentation was worked out and it now awaits commercial development. Dr. Ledingham and his group did most of the work in this field, in which he enjoys an international reputation, and brings his "know-how" and his studies with him. In addition to these, many other compounds can be made, including organic acids such as citric, lactic, etc., for which there are already well developed uses. While hardly fermentation products, the new antibiotics such as penicillin and streptomycin are produced by similar methods. These have well established uses in the medical field, are being examined as a possible remedy for certain animal diseases, and other new antibiotics may even have possibilities in reducing the effect of certain diseases on field crops.

Fermentation in its broad aspects, extending from fundamental laboratory work to pilot-plant studies and the uses for the products so obtained, will be one of the major projects in the new laboratories.

If the developments of the new laboratory are to benefit the economy and people in Western Canada, one more stage is required—commercial development. During recent years, the oil-seeds industry has been developed in this region and processing plants are now in operation. They should be in a position to use information obtained in the laboratory for

further expansion and development of their industrial activity. In the fields of building materials and fermentations, there is little in the West as yet. But the pioneer spirit is still alive, and as information becomes available, I am sure such industries will be developed, and that in the scientific and technical phases, the staff of the Prairie Regional Laboratory will be in a position to offer assistance.

Many of the staff of the new laboratory at one time worked in the Ottawa laboratory, some of them in close association with Dr. Ledingham, and the fact that they have now come together again here is, I think, a measure of tribute to qualities of leadership in the Prairie Regional Laboratory Director. Dr. Ledingham knows of a certain type of pH meter, which will be at work in the new laboratory, automatically controlling the pH of large fermentations; he knows how it was evolved, as a co-operative effort between the Division of Applied Biology and the Radio Division of the Council. May I assure him that the same co-operation, strengthened by the strong parental bond between our two laboratories, will always be available from Ottawa whenever it is needed.

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